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Estimated Amount and Distribution of TRAFFIC *in* MONTANA *for year of* 1950

STATE OF MONTANA
STATE HIGHWAY COMMISSION
HIGHWAY PLANNING SURVEY

IN COOPERATION WITH

U. S. DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS

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ESTIMATED AMOUNT AND DISTRIBUTION OF TRAFFIC IN MONTANA FOR THE YEAR 1950

Periodic estimates of traffic have been prepared in the past, as occasion required, covering the total amount of traffic in the State and also the distribution of this traffic among the various road and street systems. These estimates have been based on data obtained from the Road Use Study of 1936, and the basic data of that period have been modified to agree with the estimated trend in population and the traffic trends as determined from automatic traffic recorders. It is apparent that the basic data of 1936 are now more or less obsolete and that it is desirable to prepare a new estimate based on more reliable current information.

For the purpose of this estimate, the roads and streets in the State have been classified into the following systems:

1. Primary Rural
2. Primary Urban
3. Secondary Rural
4. Secondary Urban
5. Local Rural
6. Local Urban

The Local Rural and Local Urban Systems include all roads and streets in the State which have not already been included in the Primary and Secondary Systems.

The amount of traffic on the Primary Rural and Secondary Rural Systems is determined quite accurately since regular and comprehensive counts are made at selected points on these systems by means of portable counters, manual counts, and automatic recorders. These records are consolidated and summarized in the annual Traffic By Sections Report, and the amounts shown for the year of 1950 have been used in this estimate.

Traffic counts are also made on the Local Rural System; however, the system total is less reliable since the coverage is not so extensive and stations are spaced at greater intervals. Good coverage is generally obtained on the higher traffic roads. Lower traffic roads are counted only intermittently, and some of the very low traffic roads are not counted, except on special occasions.

No regular traffic counts are scheduled within the boundaries of cities and towns; therefore, it is necessary to estimate the traffic on the Primary Urban, Secondary Urban and Local Urban Systems. Special traffic surveys have been conducted in some of the larger cities in the State, and by analyzing the results of these surveys, it is possible to derive basic data which may be utilized to estimate the traffic in other cities. Another source of information, which may be of value in estimating traffic on the Primary Urban and Secondary Urban Systems, lies in the rural counts which are taken near the city and town limits. These counts provide an indication of the amount of traffic entering and passing through the cities on the principal thoroughfares. They are especially effective in the smaller towns where practically all of the traffic is located on the main highway.

On the basis of the foregoing procedures, a preliminary estimate was prepared for traffic on all systems, and the following results were derived:

PRELIMINARY ESTIMATE OF TRAFFIC

By System

SYSTEM	ANNUAL VEHICLE MILES
Primary Rural	1,155,696,215
Primary Urban	137,452,795
Primary Total	1,293,149,010

SYSTEM	ANNUAL VEHICLE MILES
Secondary Rural	134,248,460
Secondary Urban	15,927,140
Secondary Total	150,175,600
Local Rural	296,732,590
Local Urban	294,956,500
Local Total	591,689,090
GRAND TOTAL	2,035,013,700

In order to determine the accuracy of the traffic figure of 2,035,013,700 vehicle miles, a companion estimate was made on the basis of the sale of motor fuel that is chargeable to highway usage.

The Motor Fuel Reports of 1950 show that a total of 172,431,872 gallons of fuel was sold and taxed as being used on highways, roads and streets. In addition to this amount, another 3,223,920 gallons of fuel were used by such tax exempt agencies as the counties, cities, school districts and Federal agencies. Some of this fuel is known to be used in passenger cars, trucks and busses operating on public highways, and consequently it should be included in computations of traffic. It is impossible to determine the exact amount, so one-half of the quantity, or 1,611,960 gallons, is estimated to be chargeable to highway usage. This results in a total of 174,043,832 gallons of motor fuel which is considered as being used on public highways. Upon multiplying the 174,043,832 gallons of fuel by an average figure of 13.11 miles per gallon, as reported by the Bureau of Public Roads, a product is obtained indicating that the total traffic in the State should amount to about 2,281,714,638 vehicle miles per year.

It was apparent that there was a difference of about 246,700,938 annual vehicle miles between the traffic figures obtained by the two separate methods. This discrepancy amounted to about 12%, and it was felt that the computations should be scrutinized carefully in order to minimize this discrepancy.

The traffic figures for the Primary Rural and Secondary Rural Systems, as reported above, are considered to be accurate since they have been computed from reliable counts, and no attempt was made to review or change these figures. Although the traffic figures for the Primary Urban and Secondary Urban Systems are not based on actual counts in most instances, they were derived as the result of considerable deliberation and analysis of sample data obtained from traffic surveys in some of the larger cities. These data were also supplemented by estimates of urban traffic which were based on counts taken near city and town limits. The traffic for the Primary and Secondary Urban Systems was computed in 1948 and the results were summarized in the Traffic By Sections Report of that year. These basic figures have been expanded to allow for the normal increase in traffic between 1948 and 1950, and the expanded figure has been used in this estimate. It was felt that there was little to be gained by recomputing this traffic at this time in view of the intensive study that had been provided the subject in 1948.

It was believed that the greatest possibility of error was involved in the estimate of traffic on the Local Rural System, because of the method in which this traffic was computed. Traffic counts are taken on the Local Rural System in much the same manner as the State systems; however, the stations are spaced at greater intervals, and the coverage is not so extensive. Good coverage is generally obtained on the higher traffic roads, but the data on low traffic roads are not always up to date or reliable.

The traffic on the sections of rural road was recorded on IBM tabulating cards, and the total traffic for the system was obtained from a summary of these cards. After reviewing the figure obtained by this method, it was realized that the estimate was too low for the following reasons:

1. Many of the stations had not been counted since prewar years and many of the cards carried prewar traffic figures.
2. There is considerable fringe traffic on the edges of cities and towns which is not included in the regular system of rural counts, consequently, this traffic was not included on the tabulating cards.
3. There is an extensive mileage of low traffic roads in the State which is not covered by the regular schedule of traffic counts. Although the traffic may amount to only a few vehicles per day on these roads, the road mileage is sufficient to account for a considerable amount of total traffic.

In view of these facts, it was considered reasonable to increase the card summary figure by 30% in order to arrive at a more correct figure for 1948 traffic. A further expansion factor of 20% was applied to allow for the normal increase in traffic from 1948 to 1950.

Regular traffic counts are not taken within the limits of incorporated cities; therefore, it was necessary to estimate the traffic on the Local Urban System. The estimate of this type of traffic was based on sample data obtained from traffic surveys which had been conducted in eight cities with a fairly representative range of population. Pertinent data concerning these cities are presented in the enclosed table on Page 11.

Three separate methods were used in applying these sample data to arrive at the estimated total traffic on local streets of all incorporated cities in the State. They are described briefly as follows:

1. It may be noted from the enclosed table that the traffic on all streets in the sample cities amounted to 2.82 vehicle miles per person per day and that the average traffic per mile of street amounted to 689 vehicles per day. The unit value of 2.82 vehicle miles per person per day was multiplied by the total estimated city population of 318, 257 to arrive at a figure of 897, 484 vehicle miles per day on all city streets in the State. The predetermined figure of 347, 288 daily vehicle miles for traffic on the Primary Urban and Secondary Urban Systems was deducted from this total to arrive at a net figure of 550,196 vehicle miles per day on the Local Urban System. A similar procedure was followed in multiplying the average daily traffic figure of 689 vehicles per mile of street by the total Statewide city street system of 1730.9 miles to arrive at a figure of 1,192,590 daily vehicle miles on all city streets in the State, regardless of system. On deducting the traffic on the Primary and Secondary Urban Systems, a net figure was derived of 845, 302 daily vehicle miles on the Local Urban System. Only the streets

in actual use have been included in determining the extent of the city street mileage.

2. A more direct approach to the problem was followed in estimating Local Urban System traffic under the second method. This method consisted of computing only the traffic on the streets comprising the Local Urban System in the sample group of cities. An analysis of this traffic showed that there were 427 vehicles per day per mile of street, or 1.62 vehicle miles of traffic per day per person. The expansion of these unit values to a Statewide total showed that there was a total of 654,505 daily vehicle miles of traffic on the Local Urban System as computed on the basis of street mileage, or 515,576 daily vehicle miles as computed on the basis of population.

3. Consideration was also given to the possibility that the sample data for the traffic on the Local Urban System might be unduly influenced by the fact that many of the sample cities were located on the principal highways in the State and that the traffic of external origin might distort the basic unit values. For this reason, an attempt was made to eliminate all vehicles of external origin from the traffic computations. In order to accomplish this purpose, it was assumed that the bulk of the external traffic entered the city on the principal thoroughfares and confined the travel in the city to these same streets. By multiplying the length of these streets by

the average number of vehicles of external traffic, as determined from counts near the city limits, it is possible to approximate the amount of traffic in the city that is considered to be of external origin. The application of this procedure to the sample cities disclosed that about 21% of the traffic in the cities was of external origin and that the traffic on the principal thoroughfares was about evenly divided between external origin and local origin. Further analysis showed that the average city resident traveled 2.22 vehicle miles per day on all streets in the city, and that traffic of local origin accounted for about 543 vehicles per day per mile of street. Expansion of these unit values on the basis of total city population revealed that traffic of local origin generated 706, 531 vehicle miles per day on all streets in the cities, and when the data were expanded on the basis of street mileage, a corresponsing figure of 939,879 vehicle miles of traffic was obtained. These figures included traffic on all streets, and it was necessary to deduct traffic on the Primary and Secondary Urban Systems in order to arrive at the amount of traffic on the Local Urban System. Net figures resulted of 512, 394 daily vehicle miles on the basis of population and 557,150 vehicle miles on the basis of street mileage.

It will be noted that the estimates based on street mileage were consistently higher than those based on population. This is accounted for by the fact that the sample group of cities represented 35.73% of the population in the State, but represented only 28.06% of the street mileage in the State on the Local Urban System.

The following table presents a comparison of the results derived under the three separate methods of estimating traffic on the Local Urban System:

EXPANSION OF TRAFFIC DATA FROM SAMPLE CITIES

	Estimated Daily Traffic on Local Urban System			
	Expansion on Basis of Street Mileage		Expansion on Basis of Population	
Method Number	ADT	Vehicle Miles	VM/Person	Vehicle Miles
1	551	845,302	1.72	550,196
2	427	654,505	1.62	515,576
3	376	576,366	1.61	512,394
Average	452	692,057	1.65	526,055

GRAND AVERAGE:		
	397	Average Daily Traffic per Mile of Street
	1.91	Daily Vehicle Miles per Person
	609,056	Total Daily Vehicle Miles on Local Urban System

An analysis of the results obtained under the three methods was made to determine the relative accuracy of each method and to select the figure which seemed to be most reasonable. It appeared that the population factor showed a greater stability; however, it was felt that these figures were too low. The variation between the results obtained from the expansion of the street mileage factor was relatively great, being approximately 46% between the highest and lowest figures. These figures also appeared to be too high as a group. Although it could not be justified under statistical procedure, a decision was made to smooth out the irregularities in the estimates by averaging all results. This produced a grand average of 397 ADT per mile of street, 1.91 daily vehicle miles per person and a total estimated traffic on the Local Urban System in 1948 of 609, 056 daily vehicle miles. A expansion factor of 25% was applied to the latter figure in order to allow for the increase in traffic from 1948 to 1950. This placed the final figure for traffic on the Local Urban System at 761,145 daily vehicle miles, or the equivalent of 2.39 vehicle miles per day for each city resident and an average traffic of 497 vehicles per mile of street per day.

The population in the sample group of cities ranges from 3,975 for Sidney to 31,725 for Billings; therefore, the sample data are probably more representative of the larger cities than of the smaller cities. This tendency is offset to some extent by the fact that the two largest cities in the State (Great Falls and Butte) are not included in the computations. Although there was some evidence that the larger cities had a greater amount of traffic per person or per mile of street, there was no definite trend in this respect. This is particularly true of the traffic on the Local Urban System, so it is believed that the data obtained from the sample group of cities also may be considered as being representative of the smaller cities and towns.

The national average figure of 13.11 miles per gallon of motor fuel was also reviewed in light of conditions existing in Montana on the assumption that the figure might be too high for this State. Conditions prevail in Montana which are conducive to a higher rate of fuel consumption. The following are principal contributing factors:

1. Much of this State consists of mountainous and rolling terrain which causes a higher rate of fuel consumption

SAMPLE DATA FROM TRAFFIC SURVEYS

City	1950 Population	Street Mileage Primary	Secondary	Other	Total	Daily Vehicle Miles	VM per Person	ADT Per Mile
Billings	31,725	5.0	2.6	77.8	85.4	97,839	3.08	1146
Missoula	22,320	3.8	3.1	84.7	91.6	69,983	3.14	764
Helena	17,498	5.4	1.7	98.8	105.9	46,331	2.65	437
Bozeman	11,252	3.5	1.0	40.0	44.5	29,827	2.65	670
Kalispell	9,694	2.7	0.0	43.8	46.5	28,453	2.93	612
Miles City	9,184	3.0	0.0	47.2	50.2	21,976	2.39	438
Havre	8,094	1.5	0.9	22.7	25.1	16,373	2.02	652
Sidney	3,975	1.5	0.0	15.2	16.7	10,275	2.58	615
Total	113,742	26.4	9.3	430.2	465.9	321,057	2.82	689
State Total (Est)	318,257	152.5	45.6	1,532.8	1,730.9			
Sample Data Percentage	35.73	17.31	20.39	28.06	26.91			

ESTIMATE OF MOTOR FUEL CONSUMPTION

ROAD SYSTEM	% OF TOTAL TRAFFIC		MILES PER GALLON
Primary Rural			
Passenger	43.32		15.0
Truck & Bus	11.57		7.8
Total	54.89	Average	13.48
Primary Urban			
Passenger	5.08		12.5
Truck & Bus	1.45		8.0
Total	6.53	Average	11.50
Secondary Rural			
Passenger	4.10		12.5
Truck & Bus	2.28		7.5
Total	6.38	Average	10.71
Secondary Urban			
Passenger	0.56		12.5
Truck & Bus	0.19		8.5
Total	0.75	Average	11.48
Local Rural			
Passenger	10.33		12.0
Truck & Bus	7.92		7.0
Total	18.25	Average	9.83
Local Urban			
Passenger	10.56		12.0
Truck & Bus	2.64		8.5
Total	13.20	Average	11.30
ALL SYSTEMS			
Passenger	73.95		13.82
Truck & Bus	26.05		7.62
Total	100.00	Average	12.20

because of the curvature and rise and fall.

2. Roads in Montana are generally in poorer condition than the national average. Data obtained from the Highway Statistics Report of 1949 show that 72% of the rural road mileage in this State is non-surfaced, as compared with 48% for the national average. Only 8% of the rural road mileage has an oiled surface or better, whereas the national average is 18%.
3. Truck traffic in Montana appears to exert a greater influence on the average rate of fuel consumption. About 32% of all the vehicles registered in this State are trucks, compared to 18% for the national average. The average carried load in Montana is 6.43 tons; the national average is 5.11 tons.
4. Computations indicate that the average rate of fuel consumption in Montana for trucks is 7.84 miles per gallon, as based on truck weights and distribution reported in the Loadometer Survey of 1950. The national average is 9.02 miles per gallon as reported by the Bureau of Public Roads.

The enclosed table presents an estimate of the motor fuel consumption in Montana, distributed by type of vehicle and road system.

An estimated total traffic figure for the State was derived by multiplying the average fuel consumption of 12.20 miles per gallon by the previously determined figure of 174,043,832 gallons of fuel chargeable to highway usage. This resulted in a figure of 2,123,334,750 annual vehicle miles of traffic in the State on all highway systems. This figure compares quite favorably with the total traffic figure of 2,105,297,735 annual vehicle miles of traffic as computed from the traffic on the individual highway systems. The difference between the two figures amounts to only 0.85%.

The final estimate of the traffic on all systems is presented in the attached table. Similar data for the 1936 Road Use Study are also included for comparison purposes. It may be noted that the traffic percentages shown for the Urban Systems in 1950 are consistently higher than the corresponding figures for 1936. This situation is in agreement with the population trends which have developed in this State. An examination of the Preliminary Census of 1950 shows that the municipal population in Montana has increased about 11% during the past decade, whereas the rural population has decreased about 2% during the same period; the State as a whole has gained about 5%.

The traffic estimate for 1950 shows an increase of about 94% from 1936 to 1950; the motor fuel for highway usage shows an increase of about 84% during the same period. The discrepancy is difficult to explain unless it can be attributed to the fact that the 1936 traffic figures appear to be too low, especially the amount shown for the Primary Urban System.

The primary problem in the preparation of this estimate has been to account for enough total traffic by systems in the State to equal the total traffic as estimated from motor fuel consumption. To accomplish this, it has been necessary to liberalize the estimates of traffic on the Local Rural and Local Urban Systems. For this reason, no consideration has been given to the probability that there may be additional motor fuel used on the highways which has been purchased for alleged non-highway usage.

The extent of evasion is impossible to determine, and no allowance has been made for it in this estimate.

Because of the size of the State and the comparable prices of gasoline in adjoining states, it is doubtful that there is an appreciable amount of gasoline which is carried across the State boundaries. Any importation probably balances the exportation; therefore, there should be very little effect on traffic as computed from motor fuel sales.

The total amount of traffic in the State, as computed in this report, is based on the most reliable and up-to-date information that is available at this time. The reported figures are believed to be reliably accurate; however, minor revisions may be necessary at a later date when final Census figures become available for all incorporated cities in Montana. Further verification of accuracy may also be obtained upon completion of the contemplated new Road Use Study in this State.

ESTIMATED VOLUME AND DISTRIBUTION OF TRAFFIC

	1950 ESTIMATE				1936 ROAD USE STUDY			
SYSTEM	Road Mileage	Daily VM of Traffic	ADT	%	Road Mileage	Daily VM of Traffic	ADT	%
Primary Rural	5715.0	3,166,291	554	54.89	5419.0	1,612,269	298	55.61
Primary Urban	152.5	376,583	2469	6.53	135.0	78,276	580	2.70
Primary Total	5867.5	3,542,874	604	61.42	5554.0	1,690,545	304	58.31
Secondary Rural	2964.5	367,804	124	6.38	3282.8	193,040	59	6.66
Secondary Urban	45.6	43,636	957	.75	31.3	14,496	463	.50
Secondary Total	3010.1	411,440	137	7.13	3314.1	207,536	63	7.16
Local Rural	60757.7	1,052,480	17	18.25	57028.5	661,850	12	22.83
Local Urban	1532.8	761,145	497	13.20	1506.9	339,198	225	11.70
Local Total	62290.5	1,813,625	29	31.45	58835.4	1,001,048	17	34.53
Total Rural	69437.2	4,586,575	66	79.52	65730.3	2,467,159	38	85.10
Total Urban	1730.9	1,181,364	683	20.48	1673.2	431,970	258	14.90
GRAND TOTAL	71168.1	5,767,939	81	100.00	67403.5	2,899,129	43	100.00
ALL SYSTEMS		x 365				x 365		
ANNUAL VEHICLE MILES		2,105,297,735				1,058,182,085		